ALVA'S INSTITUTE OF ENGINEERING & TECHNOLOGY

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Shobhavana Campus, Mijar, Moodbidri

[Accredited by NAAC with A+ Grade & NBA (ECE & CSE)]

CIVIL ENGINEERING DEPARTMENT

FIRST CONTINUOUS INTERNAL EVALUATION TEST QUESTION PAPER REVIEW REPORT

Semester: VI
Course Code: **21CV63**
Course Title: **Design of Steel Structural Elements**
Modules Covered: 01
Faculty: B. Durgaprasad Baliga

Date: **03/June/2024**
Time: **9.30 a.m. – 11.00 a.m.**
Maximum Marks: 20
COs' Covered: CO1
Department: Civil Engineering

Question No.		Course Outcome (CO)	Bloom's Taxonomy Level	Marks
01	a	CO1	L2	05
01	b	CO1	L2	05
02	a	CO1	L2	05
02	b	CO1	L2	05
03	a	CO1	L3	04
03	b	CO1	L3	06
04	a	CO1	L4	10
			Total Marks	**40**

[BT Level: L1-Remember, L2-Understand, L3 -Apply, L4 -Analyze, L5- Evaluate, L6- Create]

CONSOLIDATED MARKS FOR DIFFERENT BT LEVELS

BT Level	Marks at Each Level	% Marks	Remarks
L1	---		
L2	20	50 %	
L3	10	25 %	
L4	10	25 %	

SCRUTINIZER/REVIEWER REMARKS

Approved	✓	Approved with Correction		Rejected	
Reason for Rejection					

Surendra. P. 01/06/24

Name & Signature of the Scrutinizer

Date: 01/06/24

B. Durgaprasad Baliga 09/06/24

Name & Signature of the IQAC Coordinator

Date: 01/06/2024

07/06/2024

Signature of Head of the Department

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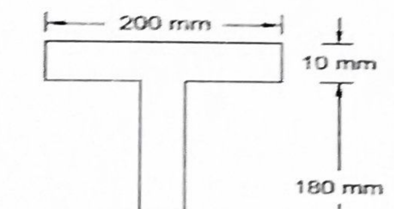
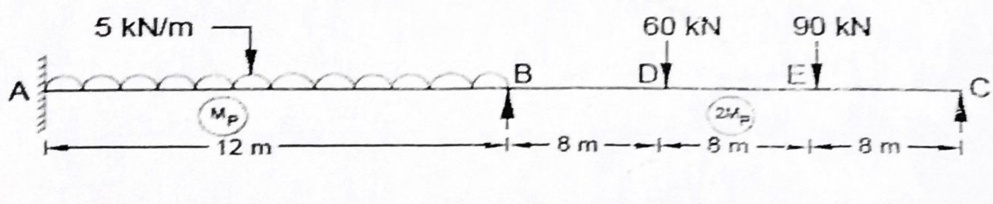
CIVIL ENGINEERING DEPARTMENT

FIRST CONTINUOUS INTERNAL EVALUATION TEST QUESTION PAPER

Semester:	VI		
Course Code:	21CV63	Date:	03/June/2024
Course Title:	Design of Steel Structural Elements	Time:	9.30 a.m. – 11. 00 a.m.
Modules Covered:	01	Maximum Marks:	20
Faculty:	B. Durgaprasad Baliga	COs' Covered:	CO1
		Department:	Civil Engineering

Note: (1) Answer any TWO full questions, choosing ONE full question from each part.
(2) Assume missing data suitably, if any.

Q. No.		Questions	Marks	CO	RBT/CL
		PART – A			
1)	(a)	What are the advantages and disadvantages of steel structures?	05	CO1	L2
	(b)	What is a limit state? Explain briefly various limit states.	05	CO1	L2
		– OR –			
2)	(a)	What are the rolled steel structures? Explain briefly with neat sketch different rolled steel sections used in steel construction.	05	CO1	L2
	(b)	What are the different loads and load combinations in the design of steel structure?	05	CO1	L2
		PART – B			
3)	(a)	What is plastic hinge? With a neat sketch, obtain an expression for hinge length of a simply supported beam with concentrated load at mid span.	04	CO1	L3
	(b)	Determine the plastic moment capacity and the shape factor of the section shown in figure. 	06	CO1	L3
		– OR –			
4)	(a)	A continuous beam ABC is loaded as shown. Determine the required Mp if the load factor is 3.2. 	10	CO1	L4

Signature of Faculty — Signature of IQAC Member — Signature of IQAC Chairman / HOD

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CIVIL ENGINEERING DEPARTMENT

FIRST CONTINUOUS INTERNAL EVALUATION TEST: SCHEME OF VALUATION

Semester:	VI	Date:	03/June/2024
Subject Code:	21CV63	Time:	9.30 a.m. – 11.00 a.m.
Subject Title:	**Design of Steel Structural Elements**	Maximum Marks:	20
Modules Covered:	C01	COs' Covered:	
Faculty :	B. Durgaprasad Baliga	Department:	Civil Engineering

Prepared by: B. Durgaprasad Baliga

NDPBL 10/06/2024

Signature of Faculty

Approved by:

Name:

Signature of IQAC Member

B. Durgaprasad Baliga

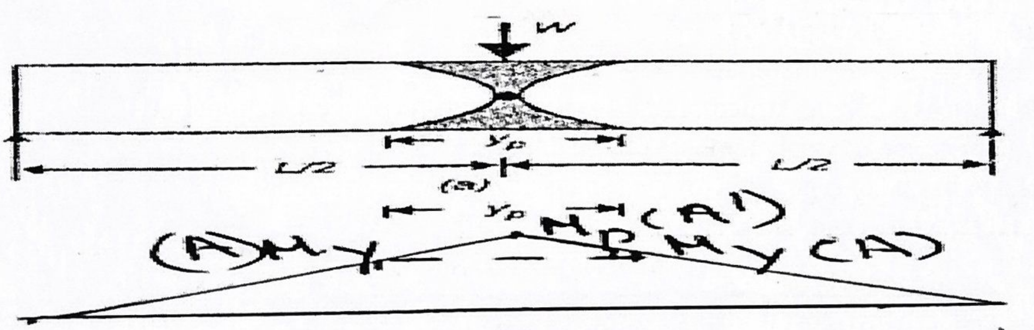
Signature of IQAC Chairman/HOD

Q. NO.	SOLUTION	MARKS
	PART – A	
1)(a)	**Advantages of Steel Structures** 1) Steel has high strength to weight ratio. 2) They are high ductile materials. 3) They are tough. 4) The properties of steel are uniform. 5) Steel behaves closer to design assumptions since it obeys Hooke's law. 6) Alteration and repair in existing structures is easy. 7) Steel structures properly maintained last indefinitely. 8) Steel has good scrap value. 9) It is an ecofriendly material. 10) Construction of steel structures causes the least disturbance to community. 11) Prefabrication of steel members can be done. 12) Design flexibility is possible for long spans using steel construction. 13) Steel structures can be easily dismantled **Disadvantages of Steel Structures** 1) The maintenance cost is high. 2) They are susceptible to corrosion. 3) They are easily attacked by fire. 4) They are susceptible to buckling and fatigue. Any 8 advantages and 4 disadvantages	04+01 = 05
(b)	A ***limit state*** is a state of impending failure, beyond which a structure ceases to perform its intended function satisfactorily, in terms of either *safety* or *serviceability; i.e.,* the structure either collapses or becomes unserviceable. Brief write-up on various limit states like Limit State of Collapse, Limit State of Serviceability that includes Limit State of Deflection, Limit State of Vibration, Limit State of Corrosion, Limit State of Durability, and Limit State of Fire Resistance.	01+04 = 05

Q. NO.	SOLUTION	M
2) (a)	Structural steel is a material used for steel construction, which is formed with a specific shape following certain standards of chemical composition and strength. They can also be defined as hot rolled products, with a cross section of special form like angles, channels and beams/joints. Structural steel is durable and can be well molded to give the desired shape to give an ultimate look to the structure that has been constructed. Sketches of rolled steel structures like I, C, T, L, Circular, Hollow Circular, Plate, and Square Shapes and brief not on all of them.	01 +04 (05)
(b)	(a) Dead Loads (DL) b) Imposed Loads (IL) i) Crane Load (CL) ii) Snow Load (SL) iii) Dust Load iv) Wave Load v) Hydrostatic Pressure and Earth Pressure vi) Impact Loads vii) Horizontal Loads on parapets and balustrades (or handrails) c) Wind Loads (WL) d) Earthquake Loads (EL) e) Erection Loads (ER) f) Accidental Loads (AL) i) Blast Loads ii) Impact of vehicles g) Secondary Effects i) Contraction and expansion effects due to temperature changes ii) Effects due to differential settlement of the structure iii) Effects due to eccentric connections iv) Effects due to rigidity of joints differing from design assumption. The following 8 load combinations are considered: 1) 1.5 (DL + IL) + 1.05(CL or SL) 2) 1.2 (DL + IL) + 1.05(CL or SL) ± 0.6(WL or EL) 3) 1.2 (DL + IL ± WL or EL) + 0.53 (CL or SL) 4) 1.5(DL ± WL or EL) 5) 0.9 DL ± 1.5 (WL or EL) 6) 1.2 (DL + ER) Page 45 of 47 7) 0.9 DL + 1.2 ER 8) DL + 0.35(IL + CL or SL) + AL	03+ 02 =(05)

PART – B

Q. NO.	SOLUTION	M
3) (a)	*Plastic Hinge*: A Plastic Hinge is defined as a yielded zone in a flexural member where large rotation can take place at a constant restraining plastic moment (Mp) of the section. Expression for the hinge length Consider a fully yielded beam as shown in figure below. Assume sagging bending moment such that the fibers above the neutral axis are in compression and those below neutral axis are in tension.	01+



Bending Moment Diagram

01

MARKS

SOLUTION

Consider a simply supported rectangular beam loaded by a gradually increasing concentrated load 'P' at mid-span, as shown in the figure above. A plastic hinge will be formed at the mid-span.

For Concentrated loads, Maximum Plastic bending Moment at mid-span, $M_P = \frac{PL}{4}$

Also, we have, Yield Moment, $M_y = f_y Z_e$

$$= f_y \frac{bd^2}{6} = f_y \frac{1}{6} 4 \frac{bd^2}{4} = \frac{2}{3} f_y \frac{bd^2}{4} = \frac{2}{3} f_y z_P$$

$$M_y = \frac{2}{3} M_P$$ 01

From the bending moment diagram, $\frac{M_P}{\frac{L}{2}} = \frac{M_y}{\frac{L}{2} - \frac{x}{2}}$

$$\frac{(L-x)}{2} M_P = \frac{L}{2} M_y$$

$$(L-x)M_P = L\, M_y$$

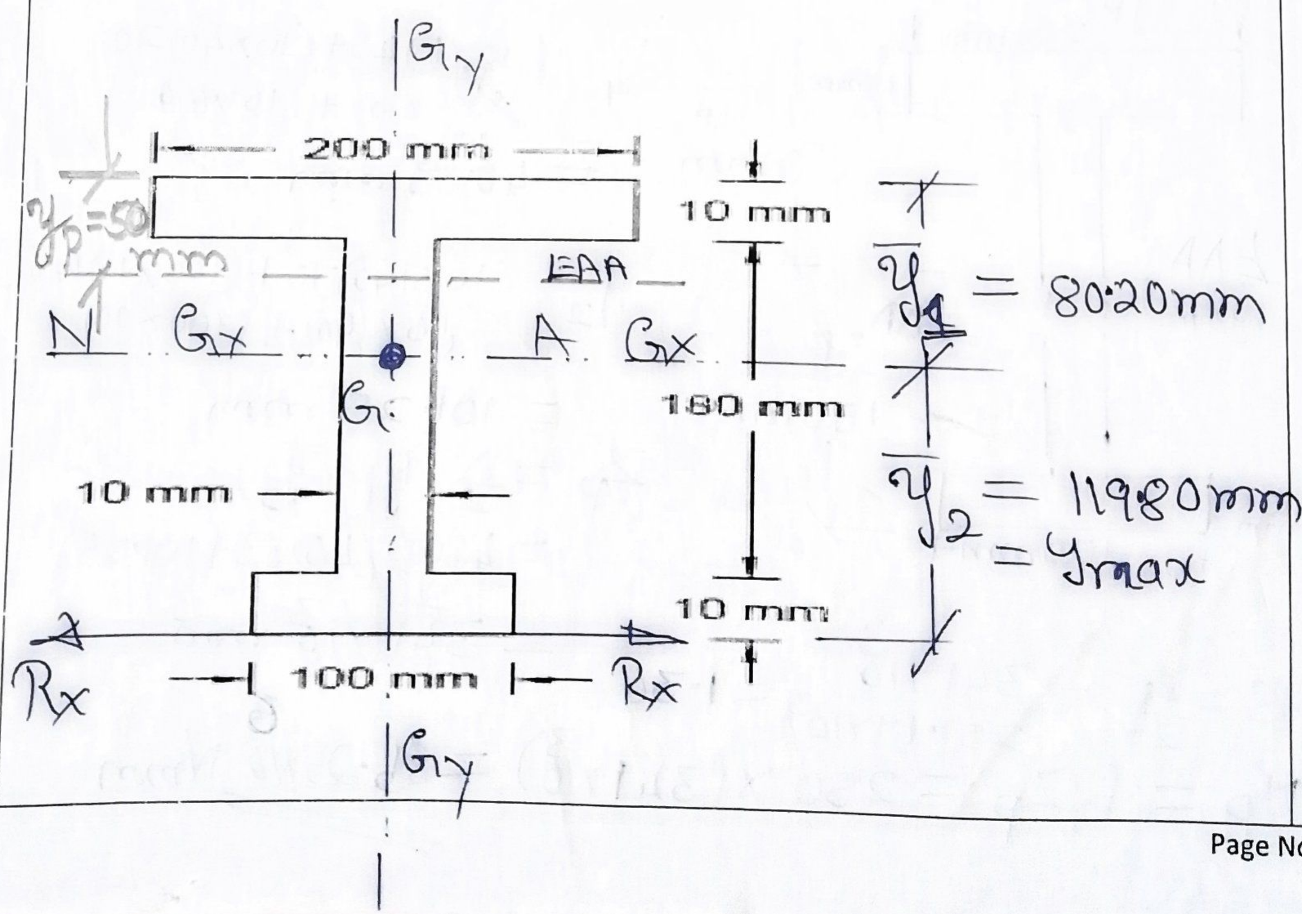
$$(L-x)M_P = L \frac{2}{3} M_P$$

$$(L-x) = \frac{2}{3} L$$

$$Hinge\ Length,\ x = \frac{L}{3}$$ 01.

Therefore Hinge Length of the plasticity zone of a simply supported beam subjected to a concentrated load at mid span is equal to $\frac{1}{3}rd$ of the span.

(b)



1) Elastic Section Modulus

$$\bar{y} = \frac{(200\times10)195 + (10\times180)100 + (100\times10)\times5}{(200\times10) + (10\times180) + (100\times10)}$$

$\therefore \bar{y} = 119.80$ mm, from RxRx

$$I_{xx} = \left[\frac{200\times10^3}{12} + (200\times10)(80.2-5)^2\right] + \left[\frac{10\times180^3}{12} + (10\times180)(119.8-100)^2\right] + \left[\frac{100\times10^3}{12} + (100\times10)(119.8-5)^2\right]$$

$\therefore I_{xx} = 30.09\times10^6\ mm^4$

$$Z_e = \frac{I_{zz}}{y_{max}} = \frac{30.09\times10^6}{119.80} \Rightarrow Z_e = 251.17\times10^3\ mm^3$$ 02

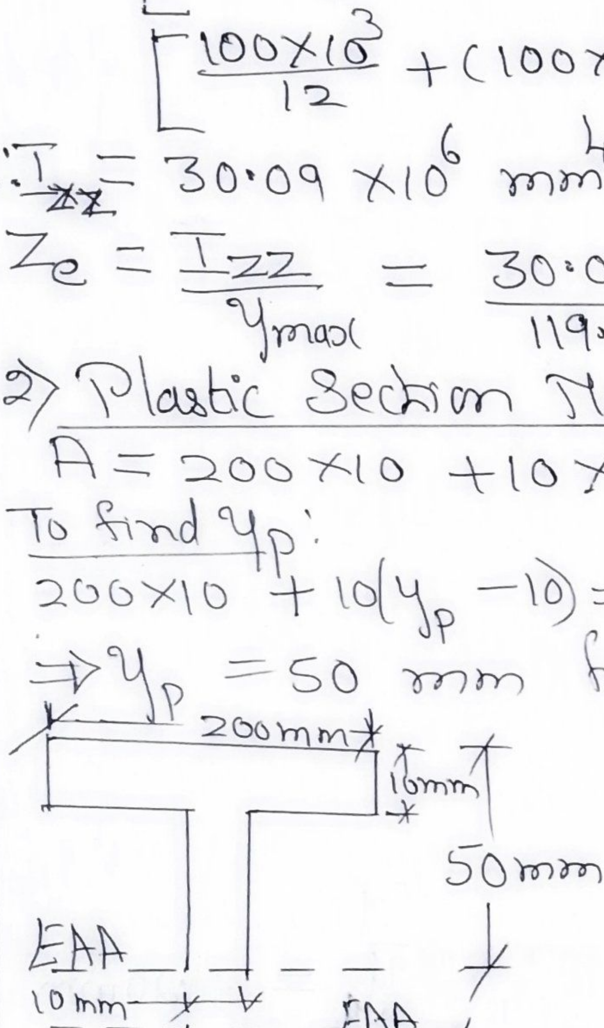
2) Plastic Section Modulus

$A = 200\times10 + 10\times180 + 100\times10 = 4800\ mm^2$

To find y_p:

$200\times10 + 10(y_p - 10) = \frac{4800}{2}$

$\Rightarrow y_p = 50$ mm from top



$$\bar{y}_1 = \frac{(200\times10)45 + (10\times40)20}{(200\times10) + (10\times40)} = 40.83\ mm$$

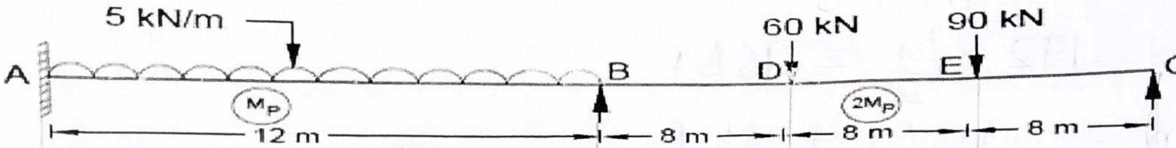
$$\bar{y}_2 = \frac{(10\times140)70 + (100\times10)145}{(10\times140) + (100\times10)} = 101.25\ mm$$

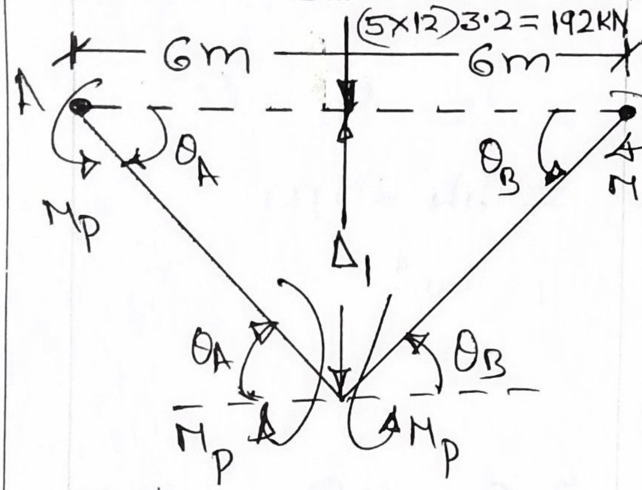
$$Z_p = \frac{A}{2}(\bar{y}_1 + \bar{y}_2) = \frac{4800}{2}(40.83 + 101.25) = 341\times10^3\ mm^3$$ 02

$$S = \frac{Z_p}{Z_e} = \frac{341\times10^3}{251.17\times10^3} = 1.36$$ 01

$M_p = f_y Z_p = 250\times(341\times10^3) = 85.25\times10^6$ Nmm 01

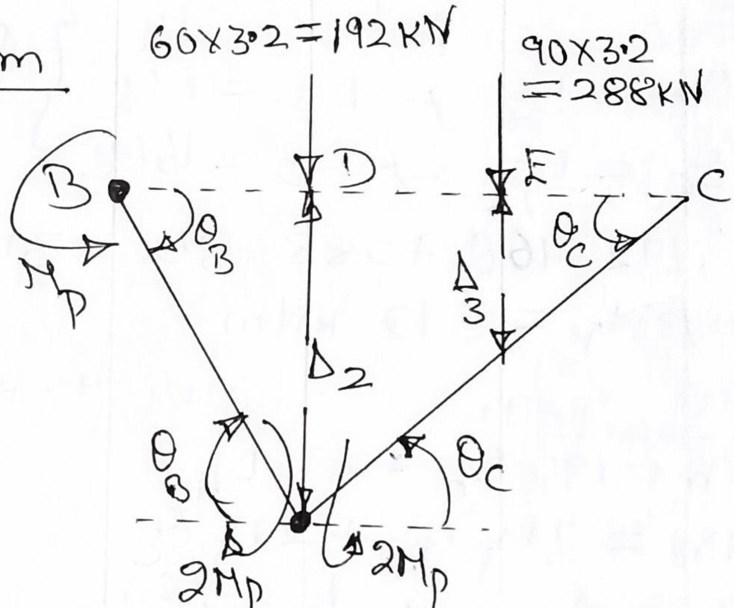
4(a)





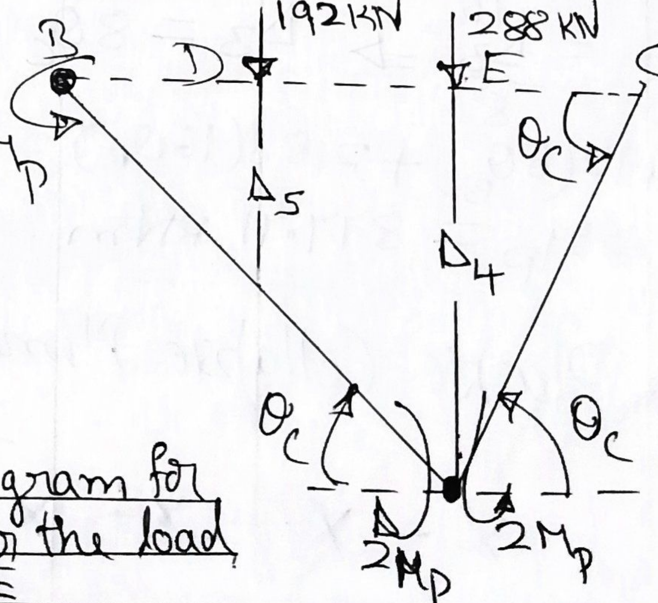
Mechanism Diagram for span AB

01



01

Mechanism Diagram for span BC under the load 60 KN at D



Mechanism Diagram for span BC under the load 90 KN at E

01

Q. NO.	SOLUTION	MARKS

For Span AB

$EW = 192 \times \frac{\Delta_1}{2} = 96\Delta_1$

$IW = 2M_p\theta_A + 2M_p\theta_B$

$\theta_A = \frac{\Delta_1}{6} \Rightarrow \Delta_1 = 6\theta_A$

$\theta_B = \frac{\Delta_1}{6} \Rightarrow \Delta_1 = 6\theta_B$ } $\Rightarrow \theta_A = \theta_B = \theta$

$\therefore 96(6\theta) = 4M_p\theta \Rightarrow M_p = 144$ kNm — 02

For span BC under 60 kN load

$EW = 192\Delta_2 + 288\Delta_3$

$IW = 3M_p\theta_B + 2M_p\theta_C$

$\theta_B = \frac{\Delta_2}{8} \Rightarrow \Delta_2 = 8\theta_B$

$\theta_C = \frac{\Delta_3}{8} \Rightarrow \Delta_3 = 8\theta_C$ } $\theta_B = 2\theta_C$

$\theta_C = \frac{\Delta_2}{16} \Rightarrow \Delta_2 = 16\theta_C$

$\therefore 192 \times 16\theta_C + 288 \times 8\theta_C = 3M_p(2\theta_C) + 2M_p\theta_C$

$\Rightarrow M_p = 672$ kNm — 02

For span BC under 90 kN load

$EW = 192\Delta_5 + 288\Delta_4$

$IW = 3M_p\theta_B + 2M_p\theta_C$

$\theta_B = \frac{\Delta_2}{8} \Rightarrow \Delta_2 = 8\theta_B$

$\theta_B = \frac{\Delta_3}{16} \Rightarrow \Delta_3 = 16\theta_B$ } $\theta_C = 2\theta_B$

$\theta_C = \frac{\Delta_3}{8} \Rightarrow \Delta_3 = 8\theta_C$

$\therefore 192(8\theta_B) + 288(16\theta_B) = 3M_p\theta_B + 2M_p(2\theta_B)$

$\Rightarrow M_p = 877.71$ kNm — 02

$\therefore$ Plastic Collapse Moment, $M_p = 877.71$ kNm — 01

X — X — X — X — X